Sludge Mass Estimate - Update

Pete Hill
WSRC, Manager, Characterization and Process Development

Barbara Hamm
WSRC, Sludge Characterization/DWPF Feed Planning

Background

- DWPF feed batch sludge mass seemed to be under predicted but extent and causes were unknown
- Uncertainty in sludge mass estimates identified as a “key vulnerability” in risk assessment
- Risk Handling Strategy included “determine if WCS is adequate for sludge and salt processing”
- Sludge Mass Review team formed in Fall of 2005

Sludge Mass Review Team

Areas of Expertise

- Tank Farm Operational Support
- Tank Farm Technical Support (Historical and current)
- Sludge composition model development and application
- Canyon Process Chemistry
- DWPF Feed Batch Planning historical approach
- SRNL Sludge Characterization experts
- Independent reviewers

Team Purpose Statement

The purpose of the team is to document the comparison of the actual sludge batch data to the predicted values and develop a path forward based on this information.

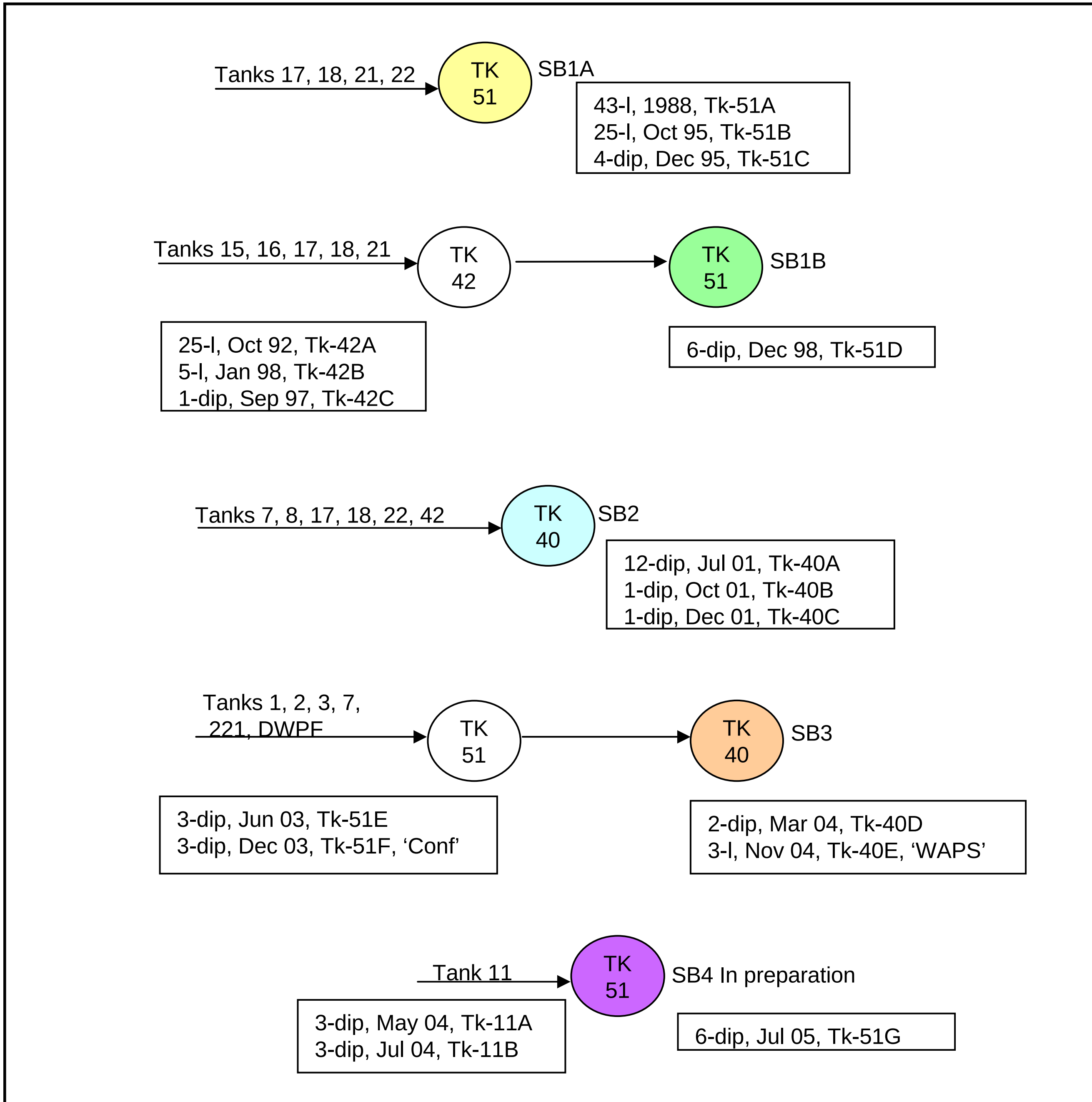
The tasks identified were as follows:

1. Assemble the data on the sludge batches processed to date using the standard format
2. Compare the sludge batch data to the sludge characterization estimates
3. Determine the magnitude of the discrepancies
4. Develop a list of possible explanations for the discrepancies
5. Develop a list of ways to address the discrepancies
6. Issue a report on the findings

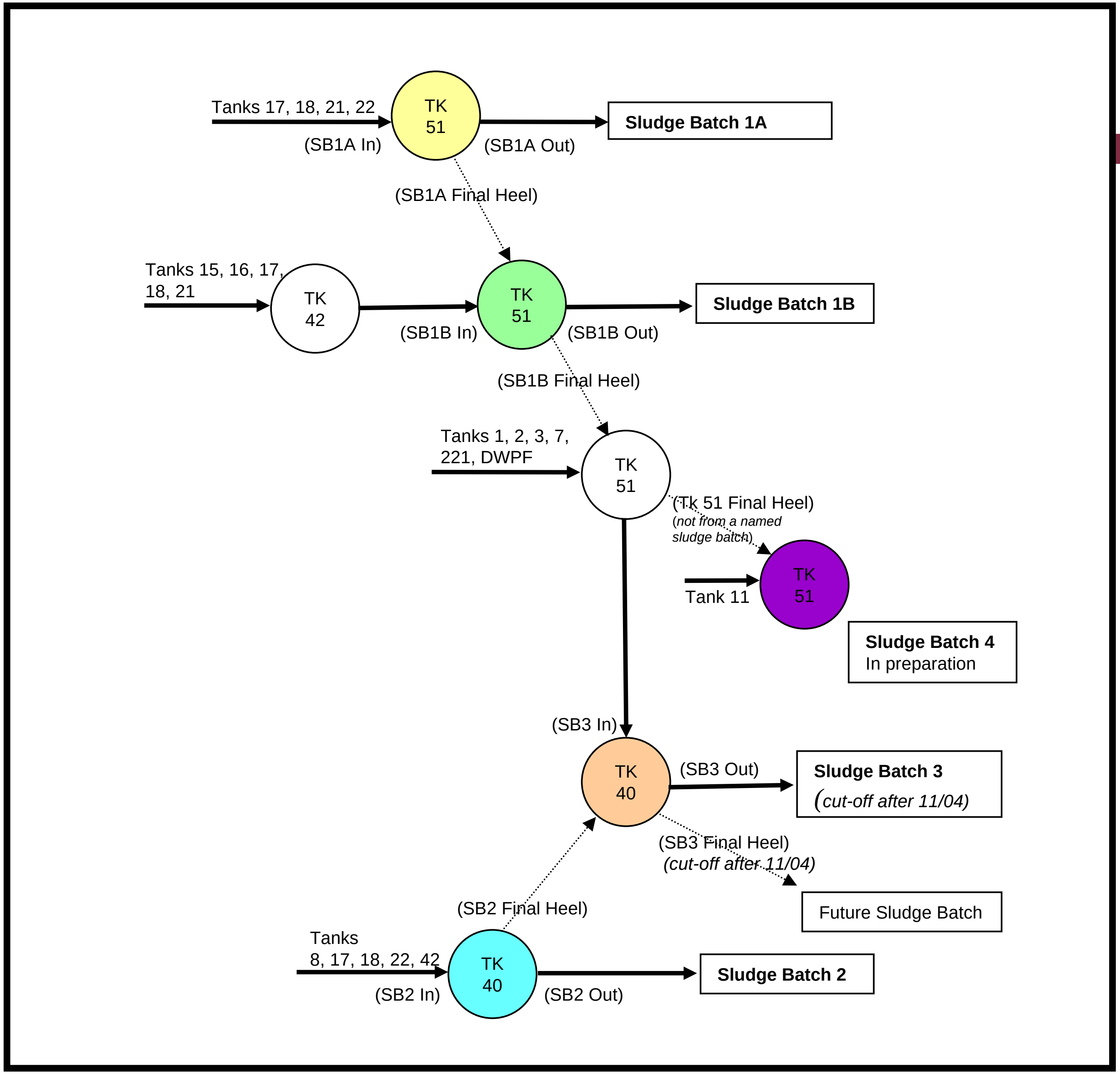
Data Analysis

1. Assemble data on the sludge batch samples, evaluate data quality, identify usable information
2. Tie sample data to tank conditions on a specific date
3. Perform material balance
4. Reconcile differences and generate final material balance based on actuals
5. Compare the actuals to the sludge characterization estimates

Samples


Tanks 17, 18, 21, 22
TK 51
SB1A
43-l, 1988, Tk-51A
25-l, Oct 95, Tk-51B
4-dip, Dec 95, Tk-51C
Tanks 15, 16, 17, 18, 21
TK 42
TK 51
SB1B
25-l, Oct 92, Tk-42A
5-l, Jan 98, Tk-42B
1-dip, Sep 97, Tk-42C
6-dip, Dec 98, Tk-51D
Tanks 7, 8, 17, 18, 22, 42
TK 40
SB2
12-dip, Jul 01, Tk-40A
1-dip, Oct 01, Tk-40B
1-dip, Dec 01, Tk-40C
Tanks 1, 2, 3, 7, 221, DWPF
TK 51
TK 40
SB3
3-dip, Jun 03, Tk-51E
3-dip, Dec 03, Tk-51F, 'Conf'
2-dip, Mar 04, Tk-40D
3-l, Nov 04, Tk-40E, 'WAPS'
Tank 11
TK 51
SB4 In preparation
3-dip, May 04, Tk-11A
3-dip, Jul 04, Tk-11B
6-dip, Jul 05, Tk-51G

Batches



Tanks 17, 18, 21, 22
TK 51
Sludge Batch 1A
(SB1A In)
(SB1A Out)
(SB1A Final Heel)
Tanks 15, 16, 17, 18, 21
TK 42
TK 51
Sludge Batch 1B
(SB1B In)
(SB1B Out)
(SB1B Final Heel)
Tanks 1, 2, 3, 7, 221, DWPF
TK 51
(Tk 51 Final Heel)
(not from a named sludge batch)
Tank 11
TK 51
Sludge Batch 4
In preparation
(SB3 In)
TK 40
(SB3 Out)
Sludge Batch 3
(cut-off after 11/04)
(SB3 Final Heel)
(cut-off after 11/04)
Future Sludge Batch
(SB2 Final Heel)
Tanks 8, 17, 18, 22, 42
TK 40
(SB2 In)
(SB2 Out)
Sludge Batch 2

DWPF Sludge Batch Estimates – Predicted vs. Measured

Batch	Predicted WCS Sludge 1.5 Model (kg calcine)	Observed DWPF Sludge Batch Characterization (kg calcine)	Percent
SB1A	173,000	315,000	182%
SB1B	144,000	319,000	221%
SB2	270,000	417,000	154%
SB3	249,000	391,000	157%
SB4	121,000	281,000	232%

Note: Calcine refers to sludge that has been heated to high temperature to convert all compounds to oxides. This reduces error in the estimates caused by mass changes as hydration waters evaporate.

Causes

- Estimates are based on canyon flowsheets that are known to be low (conservative) for purpose developed
- Canyons often ran above flowsheet
- Method doesn’t account for rework
- Method doesn’t account for Aluminum from different assemblies

Team Conclusions

Current sludge characterization model significantly underestimates the bulk mass of material in the tanks when compared to results from waste removal and DWPF batch characterization.

Current sludge characterization Model ‘As-Is’ is not suitable as a planning basis for DWPF feed mass.

An improved sludge characterization model or method is required to support DWPF feed planning.

Implications of Increased Mass to DWPF

- What is the projected number of canisters?
- How many years of operation?
- What can be done to moderate impact?
- How should we adjust waste removal planning?

Improvement Options

1. Input data as batches are processed, but leave prediction as is (rejected)
2. Adjust model based on the overall % difference observed to date (rejected)
3. Adjust model by revision of original mass estimates based on new information and insights (selected)

Model Improvement Method

1. For each waste tank with data, determine the mass of Al, Fe, Mn, Ni predicted using settled sludge data combined with historical sludge volume (with density estimate).
2. Determine the mass predicted for the tank using the canyon discharge model.
3. Determine the ratio of the two numbers.
4. Group the tanks by major waste stream.
5. Select a low, moderate, and high value based on the range of values calculated.
6. Use the ratio to scale up the predictions .

Revised Model

- Improves canyon discharge model
- Uses information based on settled sludge measurements
- Uses more realistic settled sludge density
- Uses sludge batch information

Method

Advantages

- Provides mass estimate closer to observed
- Can be adjusted as new information becomes available

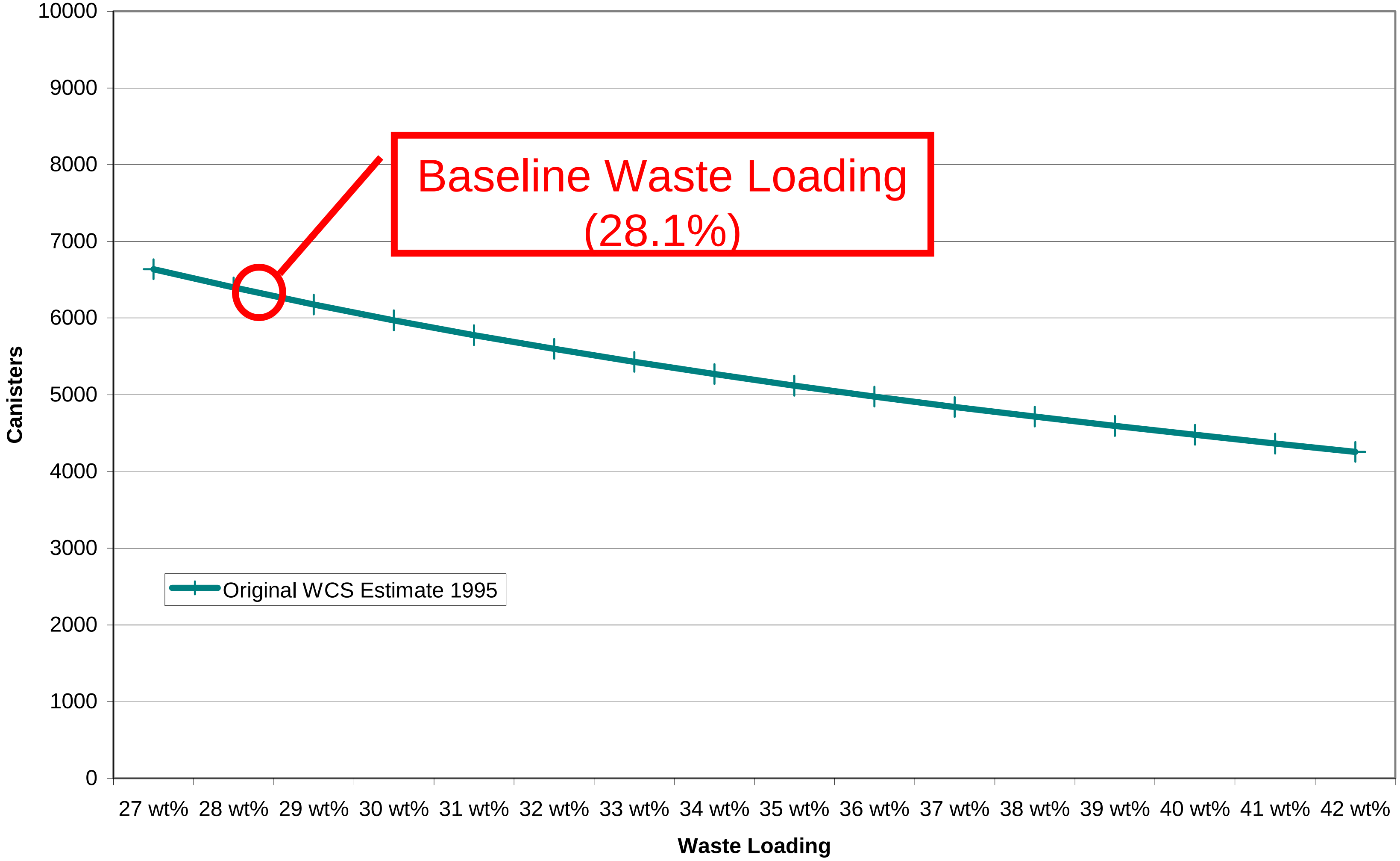
Disadvantages

- May over or under estimate individual tank contents
- Model is not fine tuned

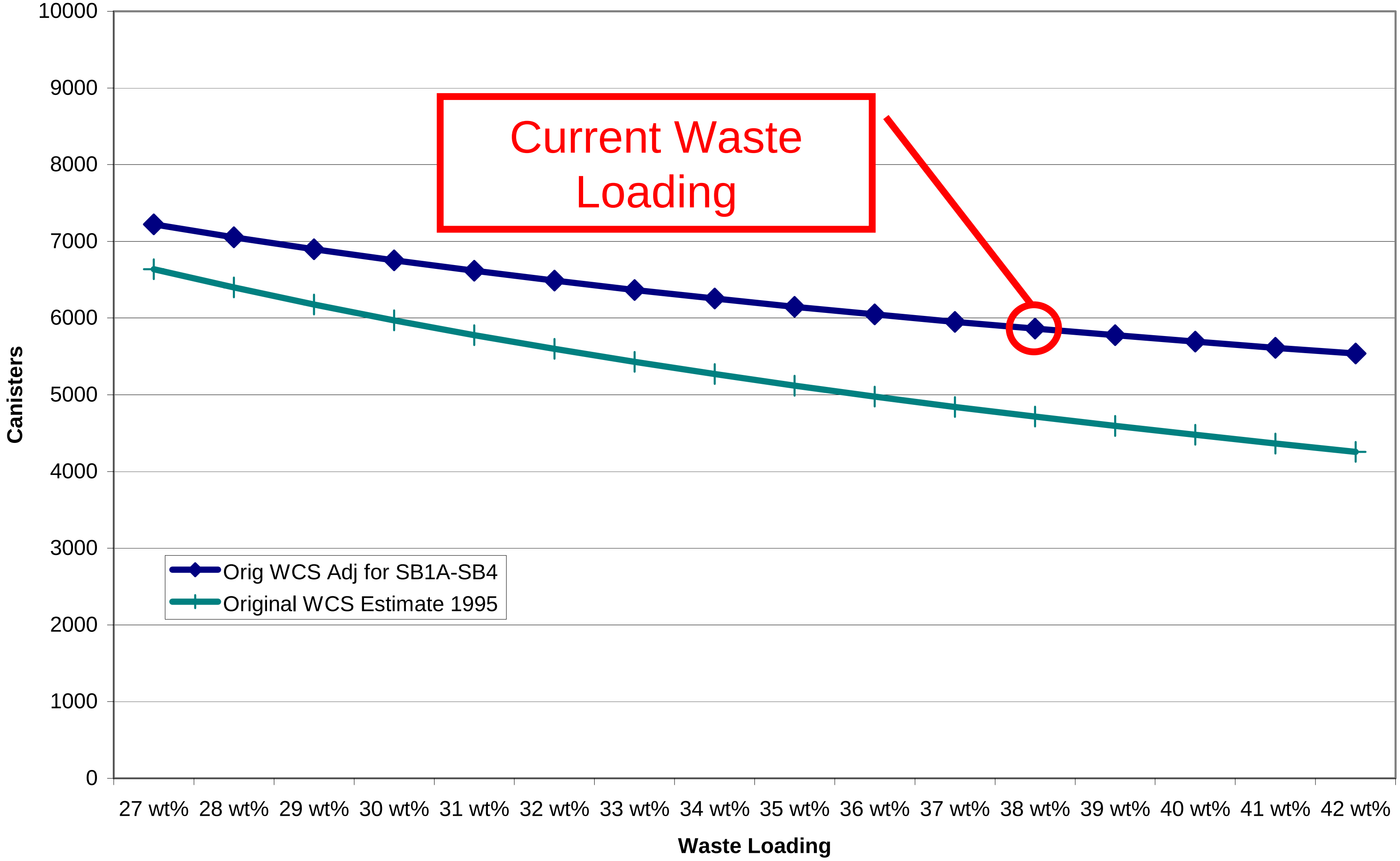
Path forward

- Revise DWPF feed batch planning
- Plan to make adjustments to predictions as sludge batches are processed
- Determine scope/cost/benefit of additional settled sludge sampling
- Conduct an independent review of work

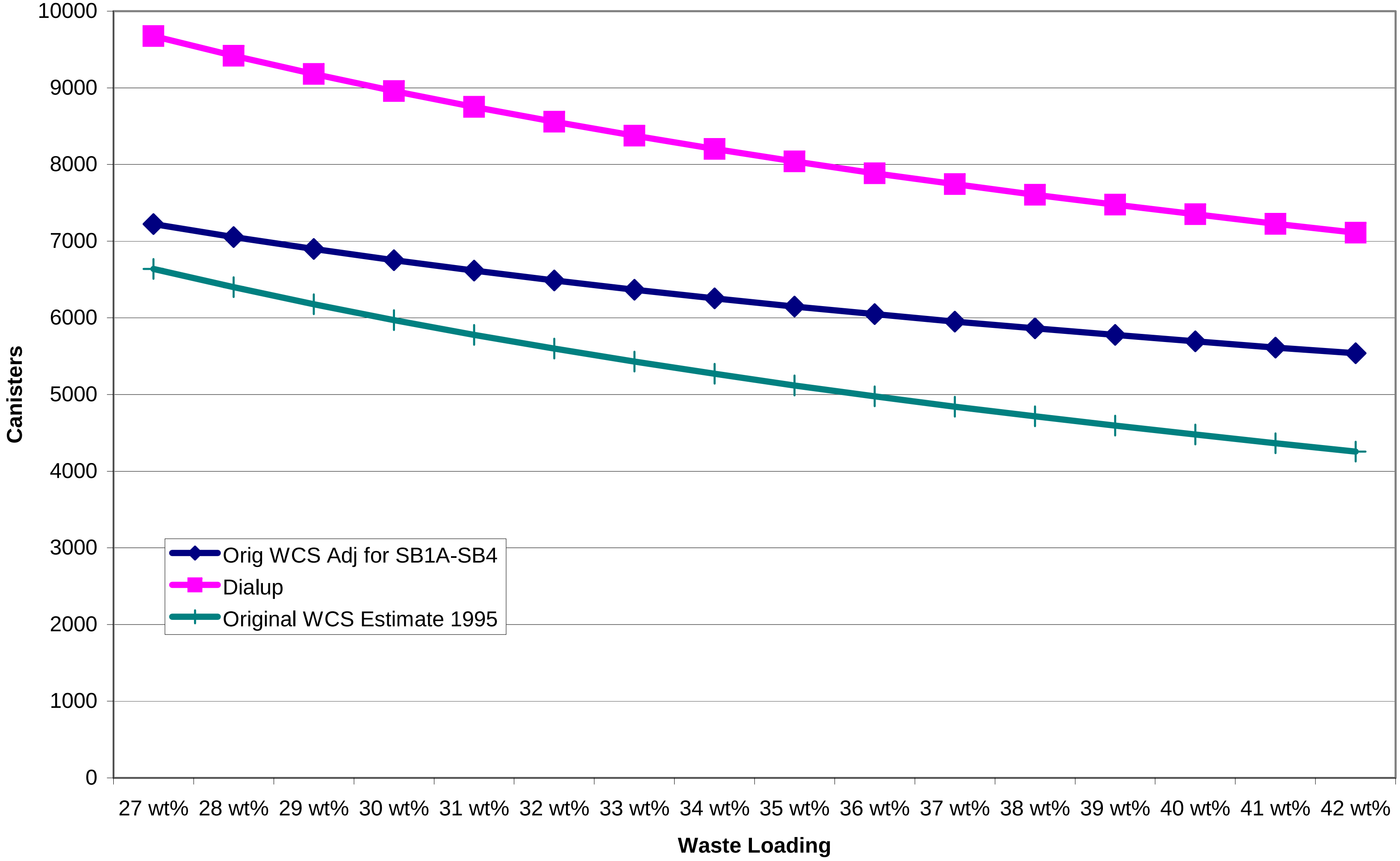
Total Canisters vs Waste Loading



Total Canisters vs Waste Loading



Total Canisters vs Waste Loading



Independent Review Team

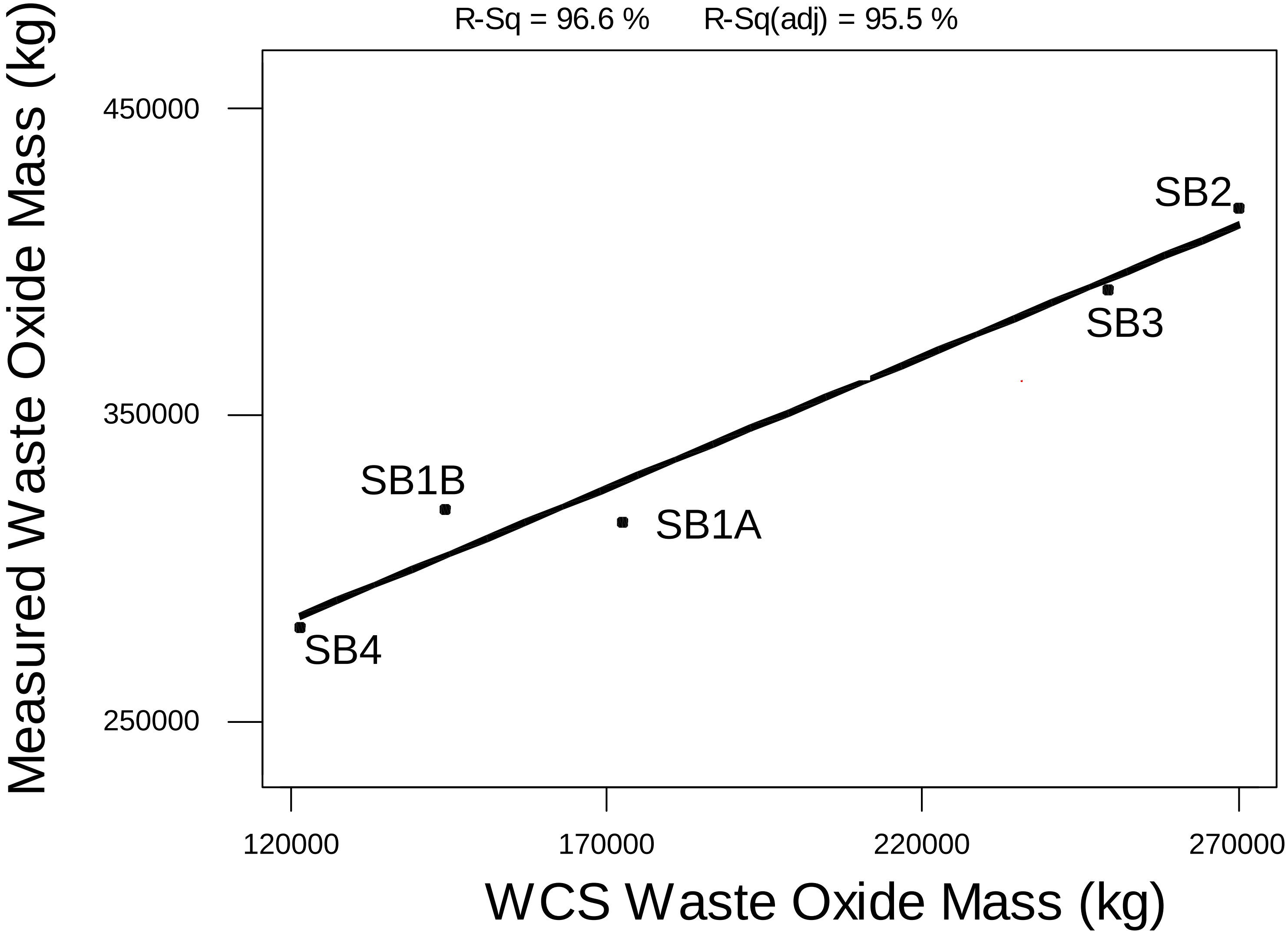
Areas of Expertise

Hanford system plan development
Hanford waste characterization
Hanford waste qualification laboratory
Hanford and SRS waste management programs
SRS sludge characterization and processing
Statistical methods and systems thinking

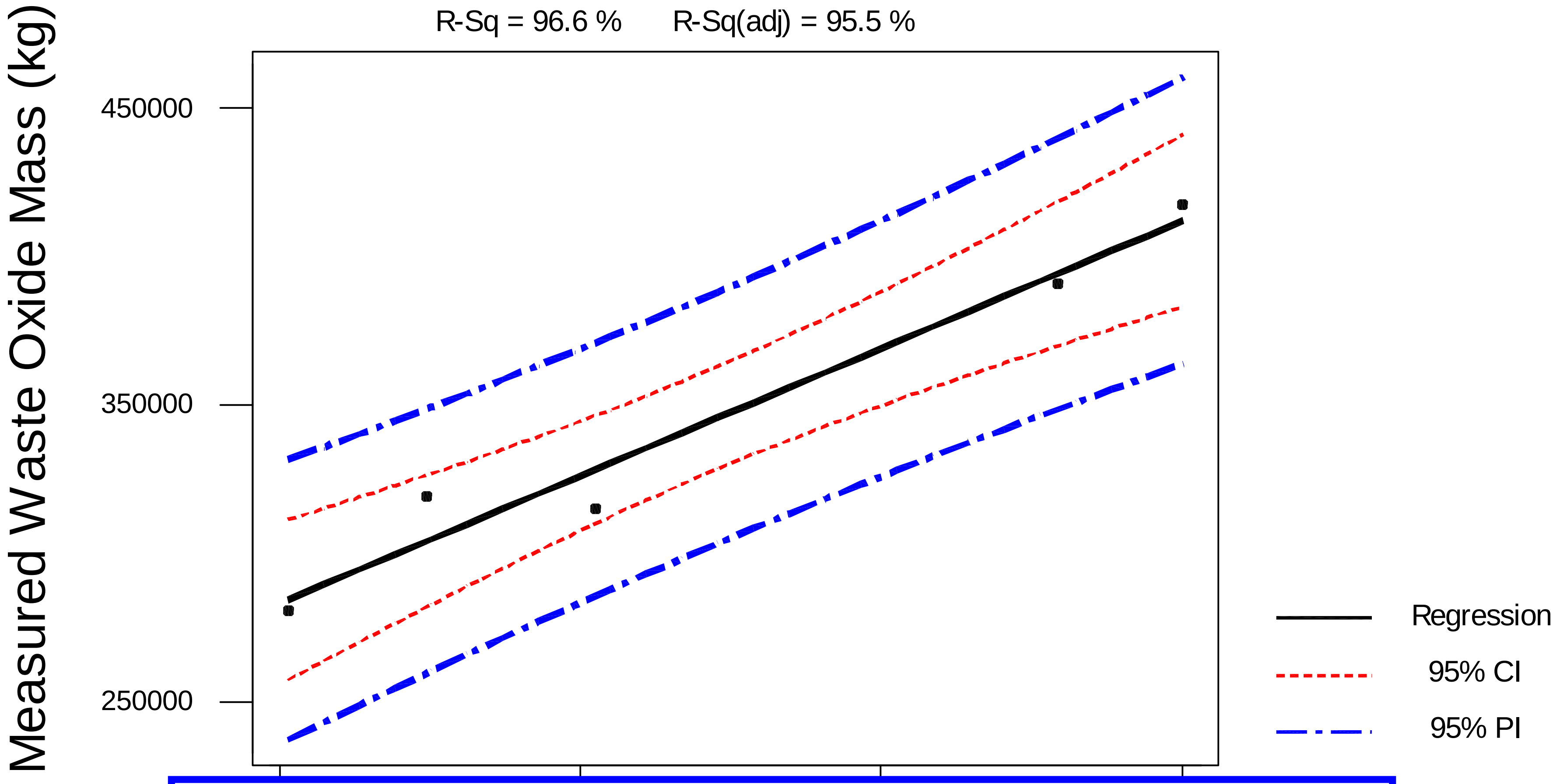
Statistical Evaluation of Uncertainty

- Utilizing SRNL’s Statistical Consulting Group
- Identified relationship between predicted and measured masses for first 5 sludge batches

Predicted (WCS) vs. Measured Waste Oxide Mass (SB1a–SB4)

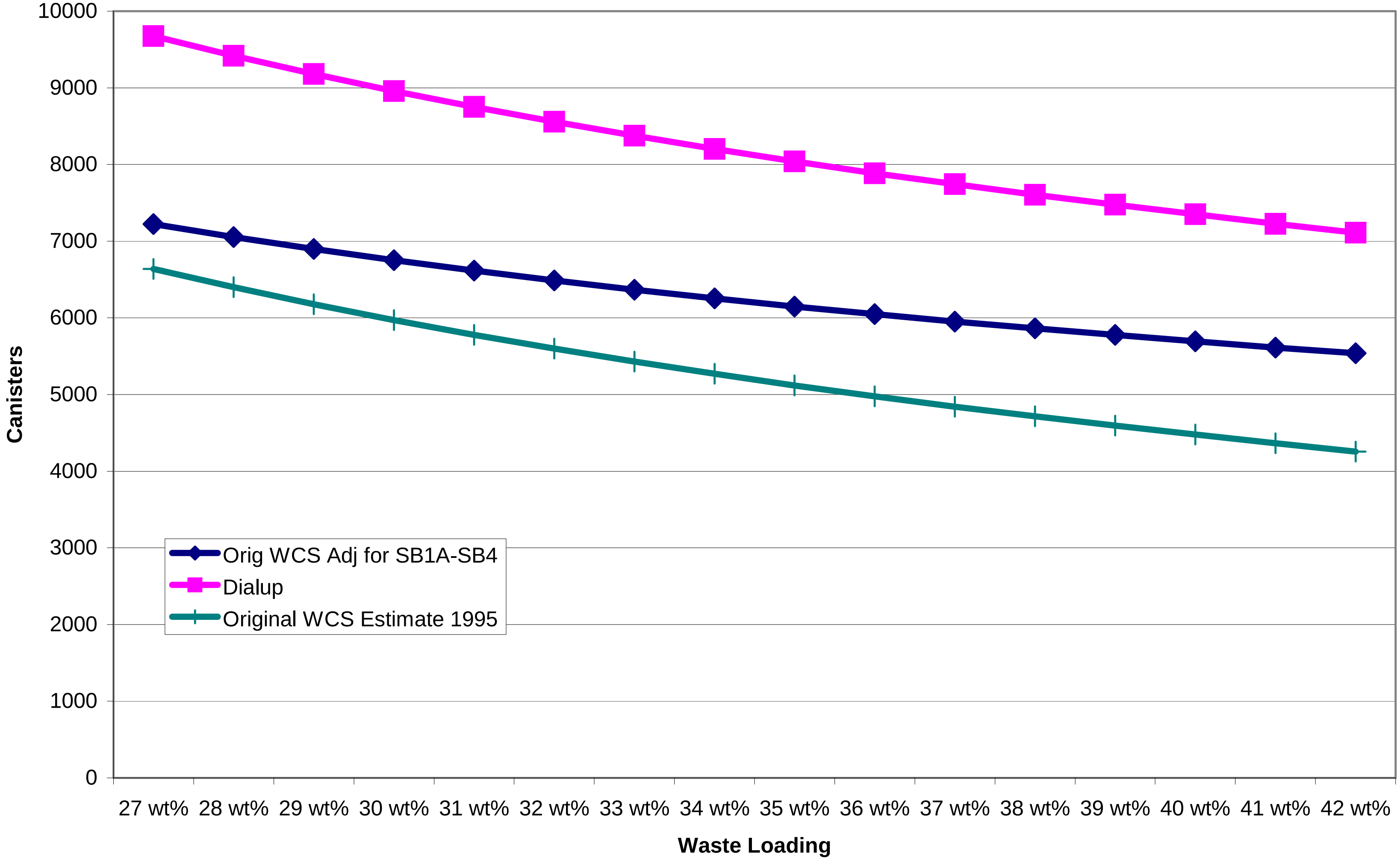


Predicted (WCS) vs. Measured Waste Oxide Mass (SB1a–SB4)

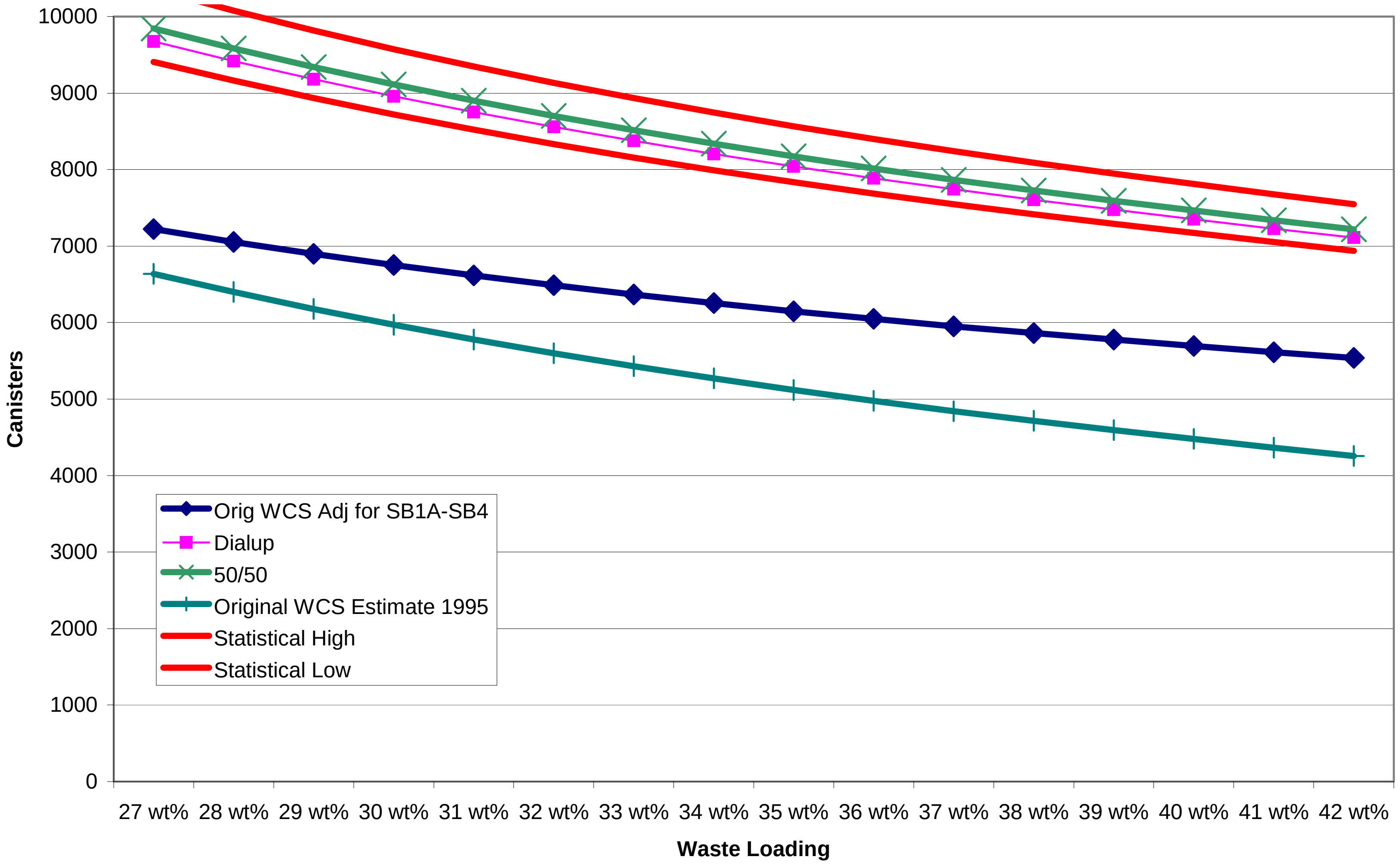


WCS does not accurately predict sludge batch mass but has displayed a consistent bias in its predictions

Total Canisters vs Waste Loading



Total Canisters vs Waste Loading

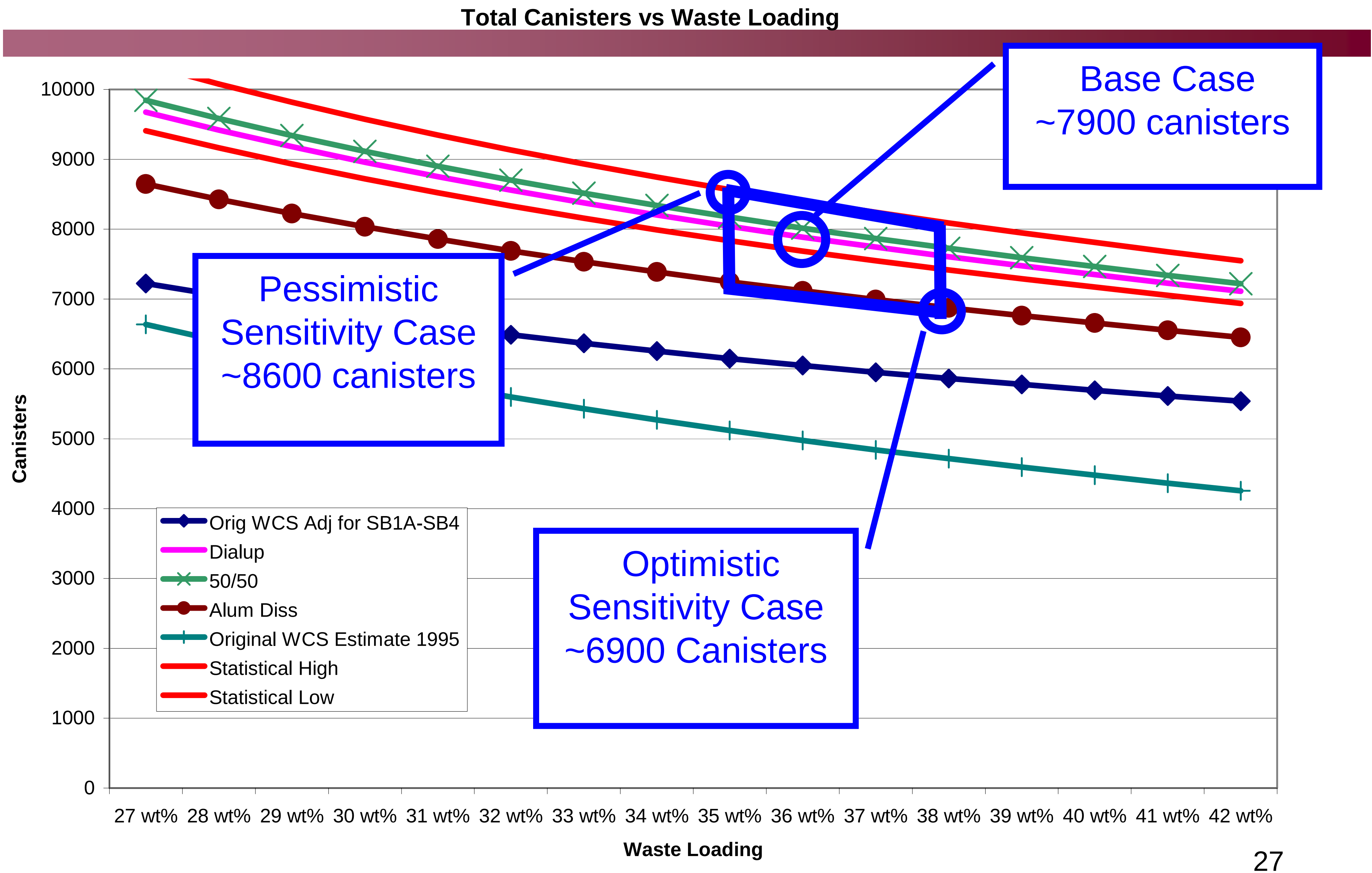


System Plan

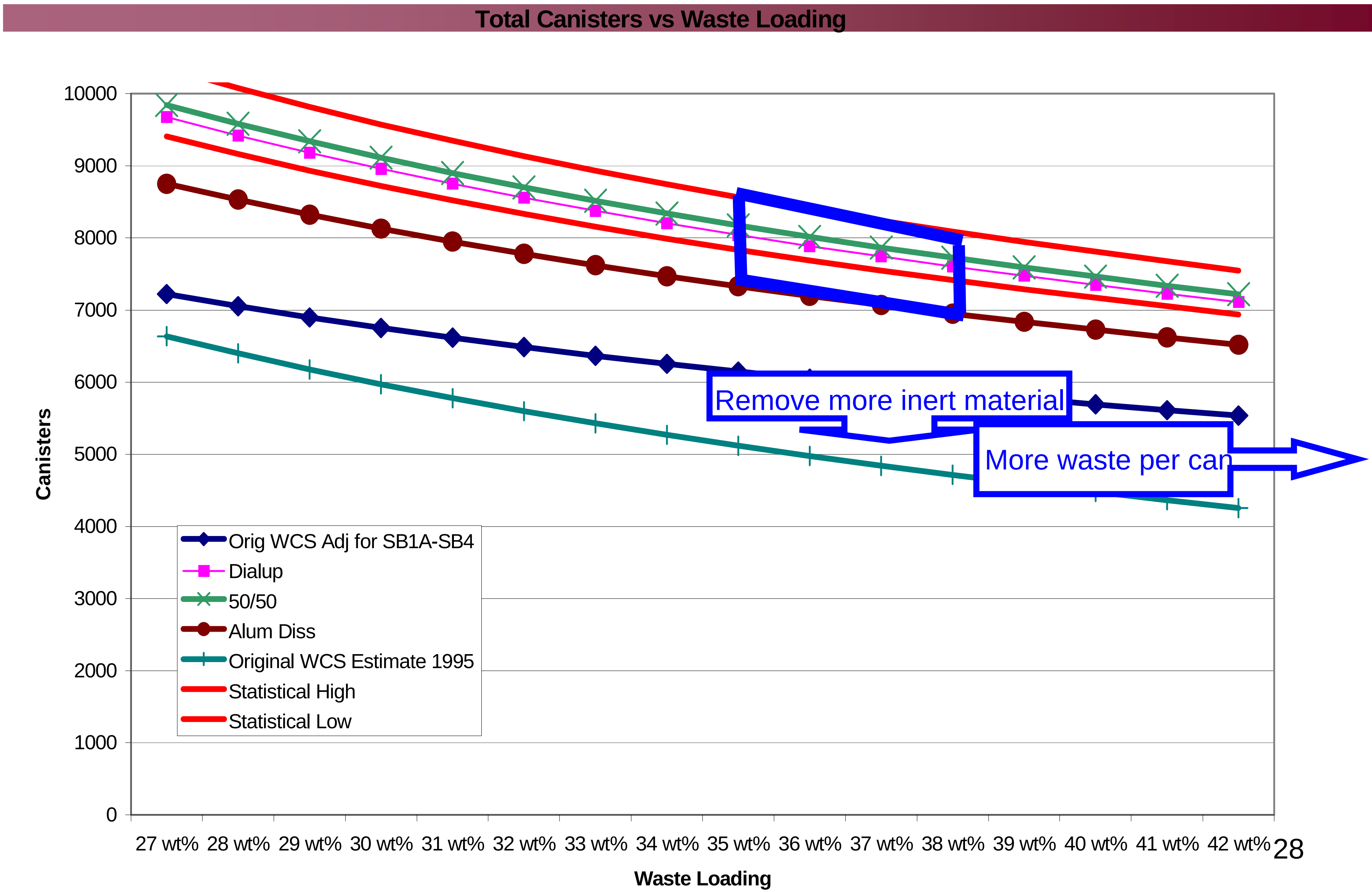
Define System Plan Base Case and Sensitivity Cases

Consistent with Assistant Secretary Rispoli's direction to implement a Project Management approach to life-cycle planning, WSRC's objective is to identify a range of possible outcomes

Total Canisters vs Waste Loading



Total Canisters vs Waste Loading



Path Forward for Sludge Mass Issue

Define Mitigation Schedule Needs via Life Cycle System Planning

Decrease Inert Mass Vitrified

- Aluminum Dissolution
- Other Technologies

Mitigate Aluminum Limitation

- Batch Sequence Optimization
- Frit Development
- Revise RW Criteria / SR Glass Quals

Increase DWPF Throughput

- Equipment Modifications
- Facility Modifications
- Canister Modifications

Reduce Estimate Uncertainty

- Improved Characterization

Selection of Mitigation Strategies